psycho-visual experiment was carried out to compare the performances of both coding systems : it aimed at measuring the difference, in bitrate, between the HDTV qualities issued from both hierarchical and simulcast scenarii. This evaluation was the first carried out on HDTV sequences coded in conformity with the MPEG2 standard: MP@H14 vs SSP@H14.

These tests are only a part of the information's needed to compare TV/HDTV broadcast scenarii. The purpose of the experiment is the evaluation of the possible loss in picture quality in the embedded mode, when a TV bit stream is embedded in the HDTV one, in comparison with the simulcast TV/HDTV transmission in which the bit streams are independent.

The experiment was organised and carried out by ADTT while the simulations were completed by HAMLET.

6.2 Simulations

The simulations carried out for these tests were based on :

- Simulcast 16/9 HDTV processings at 20 Mbit/s & 16 Mbit/s.
- Simulcast 4/3 TV processings at 4 Mbit/s & 3Mbit/s,
- Embedded 16/9 processings at 20 Mbit/s (including 16/9 TV at 4 Mbit/s).

The sequences encoded were Cross-Country Skiing, Mobile & Calendar 2, Saint-Malo, Table Tennis 2, Tamburini.

The way of encoding included some results of optimisations for HDTV processings that had been performed within the HAMLET WP2.

6.3 PSNR Results

Considering the luminance Peak Signal to Noise Ratio curves, a first analysis shows that the embedded encoding at (16+4) Mbit/s does not seem to give significant improvement on the standalone one at 16 Mbit/s, and is far away from the values of the standalone one at 20 Mbit/s.

Moreover, for embedded encoding, the quality of the base layer does not seem to be sufficient enough to obtain a good spatial prediction for the enhancement layer at such bit rate.

On the other hand even though the embedded encoding curves do not have a very good average, they are more constant for both type of pictures (the I, P & B-picture PSNR values are closer one to each other) : that can lead to a good subjective effect.

6.4 Subjective evaluation Results

From the HDTV experiment, it can be concluded with a good accuracy that the quality of the HDTV pictures in an embedded system at 20 Mbit/s is equivalent to the HDTV quality of a simulcast system at 16 Mbit/s. The difference in bitrate, for similar quality, is therefore 20 % of the embedded system bitrate.

Another conclusion which can be drawn from these experiments concerns the absolute HDTV quality. On the limited basis of the ITU-R criteria, it may be assumed that 20 Mbit/s, even with simulcast approach, is not enough to provide acceptable HDTV secondary distribution.

The statement of the parameters of a complete TV/HDTV system would require more information on the minimum acceptable quality for TV and HDTV distribution services.

7 Conclusion

We have compared scalable source coding and simulcast, both for transmission over a layered hierarchical transmission chain. We have shown that it only makes sense to have an (upconverted) base layer as fall-back if its quality is sufficiently below the bit-rate where quality saturates. We have also shown that the scalable enhancement layer can outperform the simulcast enhancement layer if the quality of the simulcast enhancement layer is below the saturation quality. In general, a conclusion on scalability vs. simulcast depends on one hand on the quality saturation and its corresponding bit-rate for a given sequence, and on

the other hand on the bit-rate of base and enhancement layer. The extra hardware complexity for SNR scalability is small, while in spatial scalability, it is roughly 1.3 times higher, depending on the subsampling of the base layer.

References

[1] "Draft specification for digital terrestrial TV," Document of DVB TM 1545 rev. 2, Jan. 1996.

[2] R. Schäfer, "$^{H}DTV_{T}$: Hierarchical Digital TeleVision Transmission," Brochure of $^{H}DTV_{T}$ at the IFA-95, HHI, Sept. 1995.

[3] "Generic coding of moving pictures and associated audio (MPEG) – Video," ISO/IEC 13818-2, ITU-T Recommendation H.262, International Standard, Nov. 1994.

[4] J. De Lameillieure and S. Pallavicini, "Scalability in MPEG-2," in *Proceedings of the HAMLET/RACE 2110 Workshop*, Feb. 1996.

[5] *Method for the subjective assessment of the quality of television pictures : Draft revised recommendation 500-4*. No. Document 11/BL/51-E, Source : Document 11/111, Genf: ITU-T, 1992.

[6] G. Keesman, A. Cotton, D. Kessler, J. De Lameillieure, J.-P. Henot, A. Nicoulin, and D. Kalivas, "Study of the subjective performance of a range of MPEG-2 encoders," in *International Broadcasting Convention*, no. 413, pp. 232–237, IEE, Sept. 1995.

[7] G. Keesman, A. Cotton, D. Kessler, J. De Lameillieure, J.-P. Henot, A. Nicoulin, and D. Kalivas, "Study of the subjective performance of a range of MPEG-2 encoders," in *International Conference on Image Processing*, IEEE, Oct. 1995.

[8] T. Selinger, "Hardware cost of SNR and Spatial Scalability for VLSI MPEG-2 video decoders," Techn. doc. of TM-DVB and $^{H}DTV_{T}$, HHI, Oct. 1994.

[9] "Simulcast/embedded encoding comparison, report on subjective evaluation," Techn. doc. of ADTT, Sept. 1995.

DEPARTMENT OF ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

36-545 MIT, CAMBRIDGE, MASSACHUSETTS 02139-4307

EX PARTE OR LATE FILED

William F. Schreiber
Professor of Electrical Engineering,
Emeritus

11 March 1996

Hon. Reed E. Hundt, Chairman
Federal Communications Commission
1919 M. St.
Washington DC 20554

MM Docket 87-268

Dear Mr. Chairman:

It has recently come to my attention that the Grand Alliance submitted Reply Comments in this docket on 22 January 1996. After carefully reviewing these comments, I have concluded that they contain a number of misstatements about interlace. On the basis of these misstatements, the Grand Alliance urges the Commission to permit an interlaced format for ATV, a step that I believe is very much contrary to the public interest.

Since the period for Reply Comments is over, and since I believe it is important to call attention to these misstatements, I herewith submit Informal Reply Comments addressed mainly to this issue. I request that these Informal Reply Comments be made a part of Docket 87-268.

It may well be asked why I have been unable to convert the members of the various ACATS committees to my views on the relative merits of progressive scan and interlace long ago. After all, this has been a consensus process where anyone who wished could attend any meeting and say what he liked.

The conclusion to which I came, reluctantly, was that most of the attendees at most of the many HDTV meetings that I attended have had, in effect, closed minds. This came about because they attended as employees of interested corporations. Their views were therefore dictated by their employer's current opinions, right or wrong, about what standards would be most in that company's interest. I rarely saw anyone openly change his mind in any way as a result of discussions at these meetings. On the other hand, Zenith and AT&T did adopt the 720x1280 progressive format first developed at MIT while I was the director of the Advanced Television Research Program.

An additional factor in this situation has been the inexperience of virtually all the technically trained committee members with the degree of interline flicker that occurs when the video signal has the full vertical resolution permitted by the number of scan lines. This is because normal TV cameras average together pairs of scan lines, reducing the vertical resolution (and, therefore, the spectrum efficiency) thus avoiding the flicker. Not one of the hundreds of engineers who saw the progressive-vs-interlaced side-by-side demonstration at MIT had ever seen this phenomenon before. (A similar demonstration was made by NIST at a meeting at Georgetown University 10-

Phone: 617-253-2579 FAX: 617-253-7302 E-mail: wfs@image.mit.edu

11 May 1995. Many of those most closely involved in the ACATS process attended the meeting, but very few bothered to see the demonstration.)

Computer engineers, on the other hand, use computer-generated video that is not vertically blurred and therefore causes intolerable flicker on interlaced displays. For this reason, virtually all computer monitors use progressive scan, and the computer industry is essentially unanimous in recommending the abandonment of interlace. This is all the more a sensible suggestion, since *I have shown in my Informal Comments that there is no advantage whatsoever is using interlace in the transmission format.* Under proper conditions, interlaced receivers might be used with progressive transmission for lower-cost lower-quality applications.

It is important to keep in mind that many viewpoints have changed radically during the period of the Inquiry in this docket. At the beginning, virtually everyone from the TV industry favored a receiver-compatible HDTV system and believed that it was impossible to transmit HDTV in 6 MHz. When contrary views were put forth by MIT, they were ridiculed, but, in the end, the Commission adopted the MIT views. In addition, hardly anyone believed that digital transmission was possible at the beginning of the process. In television, it seems that almost everyone can be wrong at the same time!

I would be pleased to provide any other information that the Commission desires.

Very truly yours,

William F. Schreiber

Cc:
Commr. James H. Quello
Commr. Andrew C. Barrett
Commr. Rachelle B. Chong
Commr. Susan Ness
Hon. Edward J. Markey
Mr. Richard K. Wiley
Mr. Larry Irving
Dr. Robert Pepper, FCC
Other interested parties

Stenographic Transcript of
HEARINGS

COMMITTEE ON
COMMERCE, SCIENCE AND TRANSPORTATION

UNITED STATES SENATE

HEARING ON
BROADCAST SPECTRUM AND TELEVISION STANDARDS

Thursday, June 20, 1996

Washington, D.C.

ALDERSON REPORTING COMPANY
1111 14TH STREET, N.W.
SUITE 400
WASHINGTON, D.C. 20005-5650
(202) 289-2260

STATEMENT OF ROB HUMMELL, DREAMWORKS, AMERICAN SOCIETY OF CINEMATOGRAPHERS, UNIVERSAL CITY, CALIFORNIA

Mr. Hummell: Good morning Mr. Chairman. My wife's uncle, Jack Kemp, insisted that I relay his regards to you this morning.

My name is Rob Hummell I am head of animation technology for Dreamworks in Los Angeles. I am officially representing in my testimony today Steven Spielberg, the Directors Guild of America the American Society of Cinematographers, the International Photographers Guild, and Panavision, which manufacturers much of the camera equipment used in motion picture photography. Steven contacted me last night and asked if I would read a brief note of his into the record. He faxed me this last night.

As we move into the next century, it is important that the standard for advanced television give the public the opportunity to see the images of film with progressive scanning, without interlace, and in the aspect ratio in which they were originally created. I, and those who have made the films in wide screen formats for decades, want to preserve that opportunity and ensure that their transmission will give future viewers the fullest possible experience. I therefore have urged the FCC to reconsider their current proposals in the interest of both the creative community and the public.

It should also be added investment has been talked a lot

about here and people talk about hundreds of millions of dollars of investment in different areas. Like the gentleman from NBC said they have invested $50 million into exploring HDTV. I might add that any one of Steven's past five films had budgets that exceeded $50 million. The investment in Cinemascope films in the past 40 years exceeds $20 billion -- $20 billion. So the Hollywood creative community has done a reasonable investment in wide-screen presentation of images.

I will go back to my statement.

I am very glad on behalf of the creative community to appear before you today and add our voice to the discussion of the draft bill you introduced into the record on May 9th. Let me say at the outset that how movies are shown on television is of very great concern to me and to all the people I represent here today. We believe that our voices have effectively been silenced or ignored in all of the many discussions that led to the proposal by the FCC to adopt the Grand Alliance proposal regarding digital television, and for that reason we are particularly pleased to be included in the hearing today.

We consider that we contribute our artistry in the creation of the most powerful and pervasive art form today, or perhaps of any time. Nonetheless, when our work is shown on TV currently it is routinely mutilated, it is colorized, it is grossly edited, speeded up electronically, or cropped into the

dimensions of a TV set. We who create movies take great pains to tell a story to a visual medium in the very best way that our ingenuity and technology will permit.

When a wide screen movie is currently squeezed into an essentially square television today, as much as 45 percent of the picture is lost. As a good example, if there was a last supper, the public would think only six apostles made it to that dinner.

[Laughter.]

Mr. Hummell: In the current 16 by 9 proposal, you would still be missing about four of those apostles. And I use the last supper as an example because through some bit of serendipity it happens to match the Cinemascope aspect ratio.

I am going to confine our comments here to discussion of that part of your draft bill that is concerned with the FCC's advanced television standard-making authority. We believe the Grand Alliance proposal is seriously flawed, and that essentially it is driven to the conclusions it reaches in order to satisfy the desires of offshore television set manufacturers. The translation of those desires will leave the U.S. consumer playing technology catch-up.

The Grand Alliance proposal proceeds in such a way that the convergence between television and computer technology is delayed, and the result will be an unnecessary cost to U.S. consumers who wish to take advantage of the advanced digital

broadcast by purchasing very high-priced sets. It is either that or set-top boxes adding an additional layer of expense.

Your draft bill proposes that there be no standard promulgated by the FCC for advanced television. While this approach is preferable to the adoption of the Grand Alliance proposal, we believe an even better approach exists. If there is a no-standard approach there will be the adoption of a de facto standard. A no-standard approach will not have the result, we believe, of leaving a cornucopia of choices in the marketplace. The TV set manufacturer's monopoly will dictate what we can buy and at what price we will pay. And to which I might add it is to their advantage to have a tiered approach, sell old technology now for about 10 years, then introduce the newer technology, then they get to sell things twice, when we have the technology today to embrace concepts like progressive scanning.

There are two matters in particular from our point of view that this minimal standard ought to address: the aspect ratio of the TV screen itself and the method of scanning. While the FCC proposes mandating a 16 by 9 aspect ratio, an engineering compromise flagrantly insulting to the public that views movies on TV -- 16 by 9 does not correspond to any aspect ratio in which any motion picture has been filmed -- we suggest a 2 to 1 aspect ratio as a minimal standard. Though this ratio, which is a rational response to the limits of

present technology, based on those we have spoken to, even the widest screen movies can be shown on TV with minimal black banding. In the vast majority of cases movies will simply appear on TV as they were photographed, and the degrading process of panning and scanning which obliterates the image will be ended.

We believe that the minimal set cost of additional glass surface is more than compensated for being able to capture the look and feel of the way in which theatrical films are photographs, and by the huge savings to consumers resulting from the refusal to mandate the Grand Alliance's costly approach. At the very least, we believe that the FCC should insist that set manufacturers not confine themselves to manufacturing sets with a 16 by 9 ratio. Better no standard in this instance, with the possibility of a flexible market response.

We also believe that, as a minimum, the FCC should insist that broadcasting be done with progressive scanning, the clear wave of the future, and the present mode embraced by computers. It is an absolute axiom that resolution is greatly enhanced with progressive scanning, and frankly we cannot see any reason why the FCC would not want to put us on a footing to adopt as quickly as possible what is clearly a more efficient technological approach.

We believe that adoption by the FCC of the Grand

Alliance's multiformat approach will have the real world effect of the continuation of most broadcasting in an interlaced format, a decades-old technology, a decades-old form of compression technology, actually, and clearly inferior to progressive scanning in terms of resolution. We believe the FCC should adopt a minimum 480-line progressive scan for picture television, and that the marketplace will respond to consumer demand to deliver even clearer pictures at higher resolution rates. Any use of interlace in the standard adds substantial cost to the consumer in getting a clearer picture.

If the FCC adopts the Grand Alliance proposal, we believe history will judge they made a decision made upon access and expediency, and not on the broad consumer public interest. As film artists, we know this opportunity has come, as it came long 50 years ago, to enable viewers to see movies and all other programming in ways much more faithful to the way the work was created and intended to be seen. We urge you to seize this opportunity now

The Chairman: Thank you very much. This is a fascinating panel. It has a lot of diversity on it. Let me ask that question, though. Many industries develop private standards, and we have oversight over the Commerce Committee, and there are constantly industry panels that develop standards in other fields of manufacturing and so forth. Why do we not let all of you develop a standard, you all sit down

and develop a standard privately? Would you be able to do that?

Mr. Keelor: Senator that standard has been developed, and it is called the Grand Alliance standard. And it was originally started to ensure that we brought free digital television to 98 percent of the American people, middle class and lower socioeconomic people who primary use free over-the-air television. To accommodate the eventual convergence of the computer and television, we brought the computer people to the table at the outset. To accommodate the move people and bring a tenfold improvement over what is being showed in television now, the Grand Alliance designed the current standard to meet what is the current international considered right aspect for motion pictures. The Grand Alliance standard has done exactly what you are asking that it do.

The Chairman: Then why are you not happy, Mr. Hummell?

Mr. Hummell: I would like to know the film that has been photographed in 16 by 9. Perhaps you can tell me. I mean, it is not internationally agreed upon in the film industry. It is a compromise that was arrived at by the engineering community as some kind of compromise between film formats, and no one was polled within the film industry about it.

As far as setting standards, I think if you allow -- since the majority of the manufacturers involved are now all offshore broadcasters -- I mean, all offshore manufacturers,

there are no American technologies here.

When you talk about the computer industry and the entertainment industry, we follow probably second and third right after the aerospace industry as sort of the leading -- what do I want to call it? Not manufacturers, but as far as enterprises in the United States economy, we are a great exporter and things like that. Right now you are meeting the needs of offshore manufacturers, which if we do not set a standard it will steamroll itself right through and they will embrace the standard that was proposed that is basically based firmly on 1974 patents granted to the NHK Corporation in Japan.

Mr. Stearns: I think our definition of standards at Compaq, and the definition of standards that was offered a moment ago are very different. Standards in our industry are not met by all the PC manufacturers getting together and deciding what is good for the marketplace. We work with Microsoft, we work with the content people, we ask our customers, and in that process, in that crucible, we are able to develop standards that work well for the customer, not because the computer industry simply decided by caveat that they have a standard.

Dr. Bingham: I continue to be amazed at the amount of misinformation that circulates. Let me start off, number one, about Americans. The 30,000 Americans that I represent who

Stenographic Transcript of
HEARINGS

COMMITTEE ON
COMMERCE, SCIENCE AND TRANSPORTATION

UNITED STATES SENATE

HEARING ON
BROADCAST SPECTRUM AND TELEVISION STANDARDS

Thursday, June 20, 1996

Washington, D.C.

ALDERSON REPORTING COMPANY
1111 14TH STREET, N.W.
SUITE 400
WASHINGTON, D.C. 20005-5650
(202) 289-2260

STATEMENT OF HON. VERNON J. EHLERS, U.S. REPRESENTATIVE FROM MICHIGAN

Mr. Ehlers: Mr. Chairman, I apologize for not having a written statement, but I was just invited late yesterday afternoon and we were in session late into the evening.

I would just comment before you leave, Senator, that I am supposed to represent the opposite point of view, but it will not be that opposite, based on what you have said. I agree on the need for timely action, but I do come with a somewhat different perspective on what that action should be. So, thank you for your comments.

Senator Stevens: And if you know anyone buying Betamax, tell them to come see me, will you please.

[Laughter.]

Mr. Ehlers: Thank you, Mr. Chairman, for inviting me to this hearing. And I will do the best to present my somewhat broader perspective on the issue.

My background is as a scientist. I have a doctorate in physics. That, in itself, does not do much on this topic but buy you a cup of coffee. But my interest in this primarily is from the computer aspect. When I began my research in 1957, I started work on one of the earliest commercial computers, which would approximately fill this room. Today, that computing power I carry around in my pocket, with a pocket computer. And, of course, the desktop models are far superior

to what I used back then.

So I have grown up with the industry, and look at this more -- since we are entering a digital era on TV, I am looking at it from the standpoint of the computers, which are intrinsically digital mechanisms.

Before I get into my testimony, I also want to comment -- you suggested you were getting the military in to testify on this issue also -- I would also encourage you to get scientists to come in and testify, particularly radio astronomers, who are clearly expert on this issue, but also have concerns about how the spectrum allocation process may infringe on their study of deep space.

In particular, I recommend that you consult with Dr. Paul Vanenbout, who is the director of the National Radio Astronomy Observatory. And he could certainly give information on that aspect of it.

My other opening comment is in response to Senator Stevens' comment about the rural issue. He is absolutely right on target. Any discussion of spectrum allocation or sale has to look at the distinction between the urban and rural issue. I represent a district which is both. I can assure you that rural stations are struggling; the urban ones are making money. And we have to take account of that in looking at allocations, costs and so forth.

Having said that, let me make some comments about HDTV

standards. I agree totally with Senator Coats: This is the direction of the future. This is the direction we must go. It will provide much better picture quality on televisions.

It will allow interactive television, where someone sitting in their living room watching a football game or a baseball, wanting to inquire about statistics of a particular player, could interrogate his television set and say, I want statistics on player number 27. That would be transmitted back to the cable company via the cable. They would pass that on to the central computers which would interrogate and display on his screen, within seconds, all the statistics he might ask for on a particular player.

You could also use this for shopping networks and a number of other interactive programs, particularly educational programs. And the advantage of digital TV is not only picture quality, but a great versatility in the sense that the television set of the future basically will be a computer. And that is inevitable.

And therein comes the problem. Because when we first began looking at HDTV standards some 8 years ago and the FCC decided to try to set standards, it was looked at primarily from the standpoint of the TV industry. That has continued, and the computer industry has been invited in along the way. But the growth of the computational ability of the computer equipment has grown so rapidly that during that 8-year period,

the picture has changed entirely.

I mention the growth over my scientific research lifetime, from a room-sized computer to a pocket-sized computer. Actually, computational power doubles approximately every 18 months. Never before in the history of the human race have we had something with such an incredible doubling rate. If that were applied, for example, to flight and the space program, we would have had approximately a decade between the Wrights brothers and landing on the moon -- to give you some idea of the accelerated pace of the computer industry and how rapidly things change there.

So we should not fault the computer industry for not getting in on the ground floor in the HDTV standards. It was a failure to recognize that by the time the standards would be set -- and I suspect no one thought it would take 8 years -- but there was a failure to recognize, by the time standards would be set, TV sets would basically be computers.

So the real issue is. How do you arrange for compatibility between computers as we know them now and TV sets as they will become? And that is the key issue.

I am convinced we must take account of that aspect. We must provide for and assist in the convergence of the digital TV industry and the computer industry. It will happen. But if we do not somehow, through your committee, through our committee, through the FCC, take account of that, provide for

it and encourage that convergence of those two, we will be doing a great disservice to both of the industries -- the TV and the computer industries -- and also to the consumers of this Nation.

Now, there are some difficulties in doing that, because I agree with Senator Coats that timing is crucial. And there are several issues that have to be identified. And let me just outline two main technical issues and three political issues.

The two technical issues involve the method of display on the TV set. Computers use progressive display on the monitor that you look at when you use a computer. It is more accurate. It displays text better. You can read it. Whereas TV sets today use an interlacing display. They go down the screen, zig-zagging, then go back and fill in the space between. So every picture -- it displays two pictures that are different in sequence.

Progressive display is the preferred method of doing it. There are still some problems with doing that with HDTV and keeping up with fast action such as sports, but I suspect those can be solved fairly readily. The new standards assume that we will continue -- that we will have both standards for HDTV -- both the interlaced standard and the progressive. I believe that is something that definitely needs reexamination. I believe we should go in the direction of the total

progressive scan.

That is one major technical issue that has to be dealt with.

Another is to identify transmission protocols to provide for error-free transmission and display of data. And that is not envisioned at the moment as well as it should be. But that is going to be essential if we are to have these industries converge and truly be able to use the TV set as part of a computer system.

So the two technical issues should be dealt with.

The political issues are as follows. The one that Senator Coats referred to, the matter of timing. I believe it is absolutely essential to do this as quickly as possible, to adopt the standards, get the industry going, so that we can maintain a competitive edge with the Europeans, the Japanese and so forth

But it is difficult to make the decision rapidly if you try to incorporate the two technical issues that I have talked about. They have been discussed by the standards committee. They are aware of them. They have recommended, in a sense, a potpourri of solutions. Rather than zeroing in on one set of standards, they have recommended a number of them, trying to put all of the different eggs available in the basket, and said time will sort out which are good. That has problems I will get to in just a moment

Another political issue is spectrum allocation and sale. And that is the main thrust of your bill, and I will not go into further detail on that.

The final political issue, and perhaps the most important one that you should be aware of today -- when you are talking about the cost of this, whether you are talking about the cost of converting the industry to digital TV or the cost involved in buying and selling spectrum, do not neglect what is the largest cost of all. And that is the cost to consumers, who go out and spend $500 to $3,500 per TV set. And if we do not just wisely at this point and the FCC does not judge wisely, we can cost consumers billions upon billions of dollars, because their purchases will be outdated or not very functional before their useful life has ended.

Senator Stevens: Mr Ehlers, could I interrupt you and just ask you a question? It seems to me you are suggesting that we take the course of mandating the FCC to deal with, on the HDTV standard, the computer side of the issue. But, as I understand it, this standard only deals with the quality of the picture presented. On the one hand, you have a relatively dumb TV that does a good job of presenting that picture. On the other hand, you have a computer that has really adaptable quality, but much higher power requirements. Will not it be easier for the computers to adopt the HDTV standard than it would be for us to mandate the industry to adopt the computer

standard?

Mr. Ehlers: No. The computers cannot adopt the HDTV standard. And that is the difficulty -- the progressive scan issue, in particular. Computers have to use progressive scan because they display text, they display fine detail. You cannot do that with the interlaced picture.

Senator Stevens: What you are saying is we should take the course to mandate everyone to convert from the dumb, cheap TV to the expensive computer standard, right?

Mr. Ehlers: No, I am not. Your phrasing the question in a prejudicial fashion, if I may say so.

Senator Stevens: It is prejudicial to me, because it sounds to me like you are saying we should mandate the industry to take a course that would cost consumers more in the initial phase, and therefore delay the transition to HDTV.

Mr. Ehlers: No, that is not true. You are assuming that digital TV sets, the computed digital TV sets, are going to be substantially more expensive.

Senator Stevens: No. I just believe they are going to be dumber. They are going to be a digital picture box, not a computer.

Mr. Ehlers: But you are contrasting what you call an inexpensive dumb box with an expensive smart box. I am saying that it will not be long before that smart box will be very price competitive with a dumb box.